

I. REAL PARTY IN INTEREST

The real party in interest is **Meritor Heavy Vehicle Technology, LLC**, assignee of the present invention.

II. RELATED APPEALS AND INTERFERENCES

There are no prior or pending appeals, interferences or judicial proceedings related to, may directly affect or may be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 1, 4, and 20-23 are pending, rejected and appealed.

Claims 2, 3 and 6 have been withdrawn.

Claims 5, 7-19, and 24 have been cancelled.

IV. STATUS OF AMENDMENTS

All amendments have been entered. Appellant submits herewith an Amendment After Final which only cancels claim 5.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Front axles are typically constructed from a forged I-beam, which is suitable for bending loads but typically not ideal for torsional and other loads. Tailoring of the I-beam to a desired application is typically limited to varying the overall beam size and flange thickness. [¶3]

The present application relates to a method of forming a complete axle from a singular tubular member. [¶2]

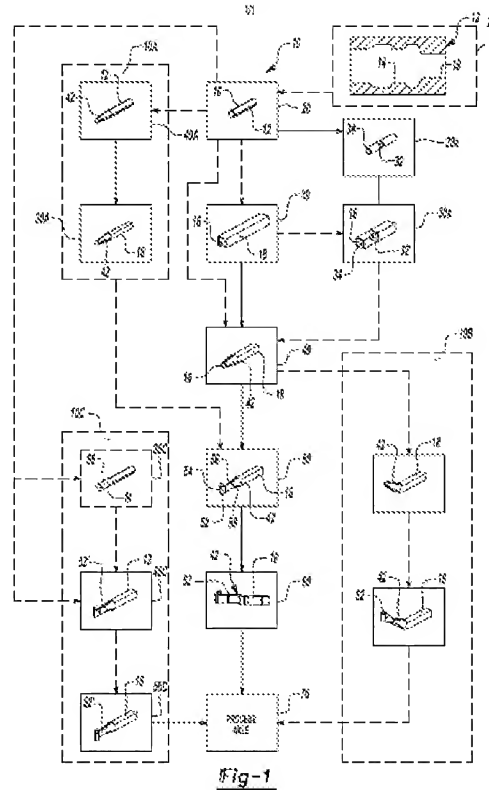


Figure 1 illustrates a flow chart of the axle forming process 10 initiated with a hollow member 12. Although clearly not limited to only such sizes, a 3/8th inch wall thickness tube is provided to carry approximately 12,000 pounds; 9/16th inch wall thickness tube is provided to carry approximately 14,600 pounds; and 3/4th inch wall thickness tube is provided to carry approximately 18,000 pounds after the process sequence of the present invention. [¶11]

The tubular member 12 may alternatively include preformed multi-wall thickness lengths 14 as indicated at step 20'. By providing multi-wall thickness lengths 14, the tubular member 12 includes predetermined increased strength sections along desired lengths and lighter thinner sections along other lengths to provide multiple advantages. [¶12]

The tubular member 12 is formed into a polygonal cross-section member 18 as indicted in step 30. Alternatively or in addition, a substantially crushable bulkhead 32 may be inserted into a cavity 34 within the tubular member 12 as indicated at step 20a. The crushable bulkhead 32 is then simultaneously formed into a polygonal bulkhead 32' at step 30 when the tubular member 12 is formed into the polygonal cross-section member 18. The bulkhead is thereby locked into the hollow member. The bulkhead 32, 32' improves the proximate strength of the

hollow member 12, 18, provides a mounting area for other axle components and efficiently transfers suspension bending moments into axle torsional shear. [¶¶13-14]

The end 16 of the polygonal member 18 is formed, preferably by a stamping, rolling, swaging, or pointing process, to provide a generally circular or frustoconical end 42 that is reduced in size relative to the hollow member 12 as indicated at step 40. Preferably, the end 16 is reduced to receive a desired end component, commonly a preformed king pin boss 52. The preformed king pin boss 52 provides a pivotal connection 54 and a substantially rounded end 56 for attachment to the frustoconical end 42 as indicated in step 50. [¶¶15-16]

After the attachment step 50, the polygonal cross-section member 18 and the king pin boss 52 may be bent to a desired shape, such as a known gooseneck shape, as indicated at step 60. Bending the members 18, 52 may yield a trapezoidal cross-sectional in the frustoconical area 42. Step 60 results in an axle assembly of the generally desired shape. [¶17]

The axle may then be processed in any manner commonly used as indicated at step 70. In particular, the axle may be heat treated in a furnace and then quenched. The axle may then be tempered and straightened, if necessary. [¶18]

Alternative paths 10A, 10B and 10C, provide the frustoconical end 42 is formed directly to the hollow member 12 as indicated at step 40A prior to the forming the tubular member 12 into a polygonal cross-section member 18 as indicted in step 30A; the bending step 60 may also be performed prior to attachment step 50; and the king pin 52' is directly formed as indicated in step 45C. Of course, these steps may be additionally or alternatively sequenced as other wise described above. [¶¶19-21]

Summary of Claim 1

Claim 1 recites:

1. A method of forming an axle assembly comprising the steps of:
 - a) providing a cylindrical hollow member 12 having an end portion 16;
 - b) forming the end portion 16 to provide a first generally circular end 42 in cross-section,
 - c) forming a section of the cylindrical hollow member 12 into a polygonal cross-section section 18; and
 - d) welding a preformed kingpin boss 52 to the generally circular end 42.

Thus, with reference to Figure 1, claim 1 recites: (c) forming a section of the cylindrical hollow member 12[¶11] into a polygonal cross-section section 18. [step 30; ¶¶13-14]

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1, 21 and 23 were rejected under 35 U.S.C. §102(a) as being anticipated by *Moses* (6122948).

Claim 22 was rejected under 35 U.S.C. §103(a) as being unpatentable over *Moses* (6122948).

Claims 4 and 20 were rejected under 35 U.S.C. §103(a) as being unpatentable over *Moses* in view of *Dickson* (6247346).

VII. ARGUMENT

§102 Rejections

Anticipation Rejection over *Moses*

Claims 1, 21 and 23 were rejected under 35 U.S.C. §102(a) as being anticipated by *Moses* (6122948). Appellant respectfully traverses these rejections. Initially, it should be understood that *Moses* ***relates to a hydroforming process*** wherein fluid forces the tube outward into the mold. [See *Moses* Col 5, lines 7-37 (reproduced below); Figure 6]

Preferably, the hollow front axle beam 40 has a substantially uniform wall thickness T and a substantially uniform outer diameter D throughout most of its entire length.

Referring now to FIG. 6, there is illustrated a portion of a hydroforming apparatus, indicated generally at 45, for forming the non-driving, hollow front axle beam 40 illustrated in FIGS. 3, 4, and 5. The hydroforming apparatus 45 is conventional in the art and includes a frame (not shown) having a pair of opposed die sections 46 and 47 that are supported thereon for relative movement between opened and closed positions. The die sections 46 and 47 have cooperating recesses 46a and 47a formed therein which together define a die cavity having a shape corresponding to a desired final shape for a workpiece 40. When moved to the opened position (not shown), the die sections 46 and 47 are spaced apart from one another to allow a workpiece 40 to be inserted within or removed from the die cavity. When moved to the closed position illustrated in FIG. 6, the die sections 46 and 47 are disposed adjacent to one another so as to enclose the workpiece 40 within the die cavity. Although the die cavity is usually somewhat larger than the workpiece 40 to be hydroformed, movement of the two die sections 46 and 47 from the opened position to the closed position may, in some instances, cause some mechanical deformation of the workpiece 40. In any event, the workpiece 40 is then filled with a fluid, typically a relatively incompressible liquid such as water. The pressure of the fluid within the workpiece 40 is increased to such a magnitude that the workpiece 40 is expanded outwardly into conformance with the die cavity. As a result, the workpiece 40 is deformed into the desired final shape for the hollow, non-driving axle housing 40.

Claims 1 recites: forming a section of the cylindrical hollow member into a polygonal cross-section section. *Moses* simply fails to disclose or suggest such a cross-section. [See *Figures 5, 9, 12 and 15*]. The hydroforming process disclosed in *Moses* – and, in fact, any hydroforming process - is particularly limited to relatively thin wall materials such as that of 1/8 inch or less and relatively soft-edged cross-sections which may not be properly interpreted as a polygonal cross-section. The claims are properly allowable.

§103 Rejections

Claim 22 is patentable independently of its independent claim

Claim 22 was rejected under 35 U.S.C. §103(a) as being unpatentable over *Moses*.

Claim 22 recites: forming the polygonal cross-section section into a substantially rectangular cross-section having a height to width ratio of approximately 1.2. The Examiner admits that *Moses* fails to disclose such a height to width ratio. Appellant understand that the Examiner is arguing that the height to width ratio is a design choice. Of course, the Examiner does not cite to any prior art. Moreover, the Examiner's rejection misses the point as *Moses* fails to even disclose or suggest a polygonal cross-section conducive to such a ratio definition. That is, all of the cross-section shapes produced by *Moses* are relatively soft non-polygonal (defined by a height to width) shapes which result from the hydroforming process. Claim 22 is properly allowable.

Claims 4 and 20 are patentable independently of their independent claims

Claims 4 and 20 were rejected under 35 U.S.C. §103(a) as being unpatentable over *Moses* in view of *Dickson* (6247346).

Applicant respectfully traverses these rejections as there is there absolutely no teaching, suggestion, or motivation to modify *Moses* in view of *Dickson* as proposed. Initially all claims are properly allowable as a hydroforming process must be performed first. That is, the hydroforming process must be prior to bending or welding as the hollow member must be first located in a die to obtain the desired cross sectional shape. Such a shape cannot be obtained after bending or after access to the interior of the hollow member is prevented, such as by welding a king pin boss in place. In particular, bending, drawing or machining as disclosed by *Dickson* [Col. 6, lines 33-54] provides stress areas in which unequal force during hydroforming could rupture the material. *Dickson* cannot be utilized to modify *Moses* as bending, drawing, or machining is not applicable to thin wall tubing necessary for hydroforming. It is improper to modify the base reference in such a way that it ruins the goal or function of the base reference. The Examiner's proposed modification would do so.

Each claim is also properly separately allowable for at least the following additional reasons.

Claim 4

Claim 4 recites respectively in pertinent part:

e) swaging the polygonal cross-section section into a generally frustroconical shape subsequent to said step c);

The Examiner admits that *Moses* fails to disclose swaging. Applicant respectfully traverses these rejections as there is absolutely no teaching, suggestion, or motivation to modify *Moses* in view of *Dickson* as proposed. As discussed above, the hydroforming process of *Moses* must be performed prior to other shaping methods so as to avoid the generation of stress areas in which an equal force during hydroforming could rupture the material.

It is axiomatic that an obviousness rejection must come from the suggestions or teachings of the references themselves. A proper suggestion or motivation to make a combination requires some benefit to result from the combination. When the additional teachings of the secondary reference do not provide any benefit to the arrangement disclosed in a primary reference, no prima facie case of obviousness exists. Because forming of a generally frustoconical shape could be performed in the hydroforming step, there is no benefit to swag a thin walled tube, therefore, there is no motivation and thus no prima facie case of obviousness provided by the proposed combination. The claims are properly allowable.

Claim 20

Claim 20 recites: wherein said step a) further comprises: providing the cylindrical hollow member with a preformed multi-wall thickness section.

The *Moses* hydroforming process cannot in any way change the wall thickness from the originating material nor be utilized with tubing of various wall thickness. Multi-wall thickness materials are simply inapplicable to a hydroforming process. This is particularly the case when combined with wall materials greater than 1/8 inch. The Examiner admits that *Moses* fails to disclose multi-wall thickness sections. *Dickson* discloses only that:

shaft that has thicker end walls. This variation in wall thickness can be accompanied by either an increase in O.D. or a decrease in I.D., or possibly both, and can be accomplished by machining, but it is preferred to accomplish it during drawing by positioning a step in a mandrel or the butt end of a mandrel closer to a tapered drawing die inlet (thinner tube wall) or slightly further away for a thicker drawn tube wall thickness, in which case the O.D. remains essentially the same but the I.D. is lessened at the tube end region to increase tube wall thickness. The drawing of

[Col. 6, lines 42-51.] Again, as discussed above, the hydroforming process of *Moses* must be performed first. That is, the hydroforming process must be prior to machining, drawing, or other operations as discussed above. In particular, machining or “drawing” operations will generate stress areas in which an equal force during hydroforming could rupture the material.

As *Moses* discloses only hydroforming, the Examiner’s proposed combination would actually ruin the hydroforming process by creating stress areas as described above. That is, it is improper to modify the base reference in such a way that it ruins the goal or function of the base reference. The Examiner’s proposed modification would do so as any machining or drawing performed prior to the hydroforming step would result in stress areas which would prevent proper hydroforming. The claims are therefore also properly allowable for this reason.

Furthermore, even if the combination were properly made, there are differences between a claimed invention and the teachings of the cited reference so that the combination does not meet the limitation of Applicant’s claims. Neither *Moses* nor *Dickson* or a combination thereof discloses any preformed multi-wall thickness section whatsoever. That is, the proposed combination, at best, discloses only providing a multi-wall thickness section through machining or the like - not forming a preformed multi-wall thickness section. The claims are therefore properly allowable.

VIII. CONCLUSION

For the above reasons, the rejections by the Examiner should be reversed. The appropriate fees have been previously paid. If any additional fees or extensions are due, please charge Deposit Account No. 50-1482.

Respectfully Submitted,

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CLAIMS APPENDIX

1. A method of forming an axle assembly comprising the steps of:
 - a) providing a cylindrical hollow member having an end portion;
 - b) forming the end portion to provide a first generally circular end in cross-section,
 - c) forming a section of the cylindrical hollow member into a polygonal cross-section section; and
 - d) welding a preformed kingpin boss to the generally circular end.
4. The method according to claim 1, further comprising the step of:
 - e) swaging the polygonal cross-section section into a generally frustoconical shape subsequent to said step c).
20. The method according to claim 1, wherein said step a) further comprises:
providing the cylindrical hollow member with a preformed multi-wall thickness section.
21. The method according to claim 1, wherein said step c) further comprises:
forming the polygonal cross-section section into a substantially rectangular cross-section section.
22. The method according to claim 1, wherein said step c) further comprises:
forming the polygonal cross-section section into a substantially rectangular cross-section having a height to width ratio of approximately 1.2.
23. The method according to claim 1, wherein said step d) is performed subsequent to said step c).

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

There are no related proceedings.